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LIFE HISTORY OF THE ORIENTAL PEACH MOTH[1] IN GEORGIA

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INTRODUCTION

The first record of the oriental peach moth in the Southern States was from Valdosta, Ga., in the fall of 1923. Adults were reared from larvae found in peach twigs from the home orchard of R. M. Shaw of that city. Valdosta is south of the Georgia peach belt, and very few peaches are grown in that locality. During the summer of the same year suspicious injury was observed on several peach trees in the town of Fort Valley, Ga., which is in the center of the peach belt, but no larvae were taken for determination. During the spring of 1924 a number of larvae were collected in twigs from these same peach trees in Fort Valley, and they were determined as *Laspeyresia molesta* Busck. It is quite probable that the insect occurred at Fort Valley in 1923, the year it was first recorded in the South. It is now known to occur in practically all of the Southern States.

It is believed that the insect may have been brought into the South in infested apples. The first *L. molesta* larva collected in the Georgia peach belt was taken from a peach tree in the rear of a grocery store. It was learned that decayed apples were sometimes thrown out in the rear of that store. An adult *L. molesta* was reared from a larva in an apple that was purchased at that place. The barrel from which it came showed that the apple was shipped from a locality in the North where the insect was known to occur. Shipments of apples had been made from there to a produce dealer in

[1] *Laspeyresia molesta* Busck; order Lepidoptera, family Tortricidae.

[2] C. H. Alden, formerly of this bureau, assisted in taking the life-history records that are embodied in this report.

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Macon, Ga., and then were jobbed to merchants in a number of localities in the State. In nearly every locality in the South where the insect is known to occur the first infestation was confined to trees within or very near to the city or town limits.

Since a survey in 1924 showed that the insect was generally distributed throughout the South, and since it had caused considerable losses to peach growers in the Middle and North Atlantic States, where it had been established for some 10 years, it was deemed advisable to undertake a rather thorough-going life-history study of the insect in the South, so that its life history under southern conditions would be known in case the enforcement of control measures ever became necessary. Consequently the life history of the oriental peach moth was studied at Fort Valley, Ga., during 1925 and 1926, and this bulletin gives a report of that work.

LIFE-HISTORY STUDIES OF THE ORIENTAL PEACH MOTH IN 1925 AND 1926

MATERIAL USED

Wintering larvae for the life-history work in 1925 were obtained from material collected at Fort Valley, Ga., during the fall of 1924, from material sent to Fort Valley from other States during that fall, and from larvae hibernating in basket liners of corrugated paper sent to the writers in the spring of 1925 by E. N. Cory, of the University of Maryland. At the close of the insect season of 1925 there was an abundant supply of oriental peach moth larvae on hand with which to start the studies of 1926. In 1925 six generations and a partial seventh were reared in the insectary at Fort Valley. In 1926 five generations and a partial sixth were reared in the insectary.

OVIPOSITION

Oviposition records were obtained by caging a known number of female moths with males, and allowing them to oviposit on peach leaves. The eggs were counted at the end of each 24-hour period and transferred to incubation cages. During the season of 1925 oviposition records were taken on 1,287 females, with which were confined 1,451 males. A total of 52,723 eggs from those females was counted during the season. The average number of eggs deposited per female (all generations combined) was 41. Table 1 gives the period of oviposition of each brood in 1925 and the average number of eggs deposited per female.

TABLE 1.—*Period of oviposition of each brood of the oriental peach moth and average number of eggs deposited per female, Fort Valley, Ga., 1925*

Brood of moths	Number of moths		Date of—		Total number of eggs deposited	Average number of eggs per female
	Male	Female	First oviposition	Last oviposition		
Spring	58	34	Apr. 16	May 6	385	11.3
First	85	103	Apr. 29	June 9	658	6.4
Second	232	189	June 1	July 5	3,188	16.9
Third	380	287	June 28	Aug. 9	8,759	30.5
Fourth	341	352	July 10	Sept. 7	22,133	62.9
Fifth	240	230	Aug. 19	Oct. 10	11,493	50.0
Sixth	95	92	Sept. 19	Oct. 14	6,107	66.4
Total or average	1,451	1,287			52,723	41.0

The average number of eggs per female of the last three generations in 1925 was much higher than the average number per female of the first four generations.

During the 1926 season oviposition records were taken on 524 females, with which were confined 479 males. A total of 16,869 eggs from those females was counted during the season. The average number of eggs deposited per female (all generations combined) was 32.2. Table 2 gives the period of oviposition of each brood in 1926 and the average number of eggs deposited per female.

TABLE 2.—*Period of oviposition of each brood of the oriental peach moth and average number of eggs deposited per female, Fort Valley, Ga., 1926*

Brood	Number of moths		Date of—		Total number of eggs deposited	Average number of eggs per female	Average number of days—			
	Male	Female	First oviposition	Last oviposition			Before oviposition	From emergence to maximum oviposition	Of oviposition	From emergence to last oviposition
Spring	199	225	Apr. 7	June 1	2,104	9.4	3.6	4.9	6.5	9.4
First	74	78	May 23	July 2	4,033	51.7	5.9	8.0	9.3	10.2
Second	65	69	June 21	Aug. 1	3,079	44.6	2.8	4.2	8.4	9.6
Third	70	79	July 23	Sept. 1	3,433	43.5	2.0	6.4	7.5	8.9
Fourth	64	66	Aug. 17	Sept. 27	3,755	56.9	3.8	5.1	7.0	7.8
Fifth	7	7	Sept. 20	Oct. 5	405	57.9	2.9	4.4	6.8	8.6
Total or average	479	524			16,869	32.2				

Temperatures above 100° or below 65° F. greatly reduced the number of eggs laid. Maximum egg deposition took place upon days with an average temperature of from 80° to 85° and with a daily range of from 70° to 95°.

INCUBATION

The eggs laid upon the sides of the glass oviposition cages were counted and then destroyed. Those laid upon leaves were counted, placed between two strips of wire screening, and observed once daily until hatched. Incubation records were taken on a total of 16,081 eggs during the season of 1925. Table 3 gives the average, maximum, and minimum periods of incubation for eggs of each generation in 1925.

TABLE 3.—*Length of incubation period of eggs of each generation of the oriental peach moth at Fort Valley, Ga., in 1925*

Brood	Number of eggs under observation	Length of incubation period		
		Average	Maximum	Minimum
		Days	*Days*	*Days*
First	243	4.3	7	3
Second	364	4.3	7	3
Third	2,010	3.3	4	3
Fourth	4,868	3.2	4	3
Fifth	3,726	3.4	4	3
Sixth	3,317	3.5	4	3
Seventh	1,553	4.0	5	3

In 1926 incubation records were taken on a total of 5,947 eggs. Table 4 gives the average, maximum, and minimum periods of incubation for eggs of each generation in 1926.

TABLE 4.—*Length of incubation period of eggs of the oriental peach moth at Fort Valley, Ga., in 1926*

Brood	Number of eggs under observation	Length of incubation period		
		Average	Maximum	Minimum
		Days	*Days*	*Days*
First	1,017	5.7	9	3
Second	1,420	3.7	5	3
Third	1,238	3.7	4	3
Fourth	1,084	3.4	4	3
Fifth	1,106	3.7	4	3
Sixth	82	4.2	5	4

LARVAL STAGE

LARVAL FEEDING PERIOD

The stock-jar method was used for the determination of the feedings period. Where the larvae were reared in cut twigs some difficulty was experienced in keeping the twigs from wilting. It was found necessary to supply fresh water daily and to replace them occasionally with fresh twigs in order that the larvae might reach maturity in a healthy condition. Much less difficulty was experienced when the larvae were bred in peach fruit, although occasionally the peaches were so serverely attacked by a rhizopus rot that the larvae were apparently unable to utilize them as food. The length of time from the date the larvae hatched until they entered a pupation stick to spin a cocoon was taken as the larval feeding period.

Records on the feeding period of 5,017 larvae were taken during the season of 1925; 437 of these were reared in peach twigs and 4,580 were reared in peach fruit. Table 5 gives the average, maximum, and minimum larval feeding periods for each brood during 1925.

TABLE 5.—*Length of feeding period of each brood of larvae of the oriental peach moth at Fort Valley, Ga., in 1925*

Brood	Number of larvae		Length of larval feeding period					
			In twigs			In fruit		
	In twigs	In fruit	Average	Maximum	Minimum	Average	Maximum	Minimum
			Days	*Days*	*Days*	*Days*	*Days*	*Days*
First	10	86	21.0	28	16	16.3	35	10
Second	50	93	10.5	17	6	11.3	24	6
Third	293	457	8.4	14	7	10.3	15	7
Fourth	73	1,125	9.4	16	8	12.0	17	8
Fifth	11	1,216	11.2	17	6	11.4	20	7
Sixth	------	1,141	------	------	------	14.7	41	7
Seventh	------	462	------	------	------	19.2	39	11

During the season of 1926 larval feeding records were taken on 1,938 individuals. The stock-jar method was used, as in 1925, and

all larvae were reared in fruit. Table 6 gives the average, maximum, and minimum larval feeding periods for each of the broods of 1926.

TABLE 6.—*Length of feeding period of each brood of larvae of the oriental peach moth at Fort Valley, Ga., in 1926*

Brood	Number of larvae	Length of larval feeding period in fruit		
		Average	Maximum	Minimum
		Days	*Days*	*Days*
First	362	13.7	23	9
Second	607	11.1	18	7
Third	430	10.8	21	7
Fourth	260	10.6	22	7
Fifth	268	12.9	26	8
Sixth	11	16.5	21	14

COCOONING PERIOD

As the larvae entered the pupation sticks after the end of the feeding period, they were given numbers and then examined daily till pupation occurred. This period from the time they entered the sticks until pupation is designated as the cocooning period, regardless of whether cocoons were spun or not. The great majority of larvae spun cocoons the same day they entered the sticks, a few delayed several days, and a very few pupated without spinning cocoons. A very small proportion of the overwintering larvae passed the winter in pupation sticks and pupated in the spring without ever having spun a cocoon.

Tables 7 and 8 give the length of the cocooning period of larvae during the seasons of 1925 and 1926 at Fort Valley, Ga., and also the total length of the larval stage of each brood (larval feeding and cocooning periods combined).

TABLE 7.—*Length of larval feeding period and total length of larval stage of each brood of the oriental peach moth, Fort Valley, Ga., 1925*

Brood	Average length of larval feeding period—		Average length of cocooning period (from end of feeding period to time of pupation)	Total average length of larval stage—	
	In twigs	In fruit		In twigs	In fruit
	Days	*Days*	*Days*	*Days*	*Days*
First	21.0	16.3	[1] 6.5	29.5	24.8
Second	10.5	11.3	3.1	13.6	14.4
Third	8.4	10.3	2.8	11.2	13.1
Fourth	9.4	12.0	2.9	12.3	14.9
Fifth	11.2	11.2	3.0	14.2	14.2
		[2] 12.9			
Sixth		10.9	2.6		13.5
		[3] 17.1			
Seventh		[3] 19.2			

[1] Larval feeding and cocooning periods.

[2] The cocooning periods of some of these individuals were abnormal, as 1 took 41 days, 1 took 34 days, 4 took 32 days, 1 took 31 days, 2 took 28 days, 3 took 25 days, 2 took 23 days, 1 took 21 days, 1 took 19 days, and 1 took 18 days.

[3] Hibernating larvae.

TABLE 8.—*Length of larval feeding period and total length of larval stage of each brood of the oriental peach moth, Fort Valley, Ga., 1926*

Brood	Average length of larval feeding period	Average length of cocooning period (from end of feeding period to time of pupation)	Total average length of larval stage [1]
	Days	*Days*	*Days*
First	13.7	3.8	17.5
Second	11.1	2.9	14.1
Third	10.8	2.7	13.5
Fourth	10.3 [2] 12.6	2.5	12.8
Fifth	11.1 [2] 13.6	2.7	13.8
Sixth	[2] 16.5		

[1] Larval feeding and cocooning periods. [2] Hibernating larvae.

HIBERNATION OF LARVAE

After the completion of the larval feeding period, larvae entering the pupation sticks were given numbers and examined daily for pupation until cold weather had stopped transformation. The hibernating larvae were then examined approximately every two weeks during cold weather and once a week during warmer weather until spring. They were then examined daily. The pupation sticks containing the overwintering larvae were kept in glass jars in a screened insectary with a wooden roof.

Newly hatched larvae appeared in the field in the spring of 1925 about two weeks earlier than in the insectary. This was believed to be due either to lack of sunshine or to an insufficient supply of hibernating larvae in the insectary to represent accurately the field conditions.

In the fall of 1925 larvae were also placed in hibernation in a cage with screened sides and top. This cage was situated in the open, where the sun could reach it from all sides. In 1926 the first male moth in this cage emerged April 6, and the first from the insectary material, March 28. The first female moth in the cage emerged April 4, and the first in the insectary, April 7, The first eggs of the outdoor moths were laid April 7 and the first eggs of the insectary moths, April 9.

Very close agreement between insectary and outdoor-cage records was evident in 1926. It therefore seems possible that the differences noted the previous season were due to the small number of individuals under observation in the insectary. On the other hand, the earliest larvae noted in the field in 1925 might have been hatched from eggs deposited by moths which emerged very early because the overwintering larvae had hibernated in a position exceptionally favorable for early spring emergence.

In 1925, 12.1 per cent of the larvae of the fifth brood in the insectary, 64.6 per cent of the sixth, and 100 per cent of the seventh brood entered hibernation, there being seven broods that year. Table 9 gives the period of hibernation of these three broods of larvae that passed through the winter of 1925–26, and the date the first and last larva of each brood entered hibernation.

TABLE 9.—*Length of hibernation period of three broods of larvae of the oriental peach moth that passed through the winter of 1925–26 at Fort Valley, Ga., and the dates the first and last larva of each brood entered hibernation*

Brood of larvae (1925) [1]	Date first larva entered hibernation	Date last larva entered hibernation	Larvae surviving the winter	Proportion of 1926 spring-brood pupae derived from different broods of larvae of 1925	Length of hibernating period (from time of entering pupation sticks until pupation)		
					Average	Maximum	Minimum
	1925	1925	*Number*	*Per cent*	*Days*	*Days*	*Days*
Fifth	Aug. 26	Sept. 23	83	7.8	200.2	276	164
Sixth	Sept. 6	Nov. 19	598	56.3	181.1	232	140
Seventh	Sept. 5	Nov. 21	381	35.9	174.5	254	131

[1] Fourth-brood larvae existed when the Elberta peaches were being picked. The Elberta is the last commercial variety to ripen in Georgia. No fourth-brood larvae hibernated in 1925.

Table 10 gives the percentage of broods of larvae of 1925 entering hibernation, and the percentage of mortality of each brood during the winter of 1925–26. These data are derived from material which hibernated in the insectary and therefore do not accurately represent the mortality which occurred in the field.

TABLE 10.—*Percentage of broods of oriental peach-moth larvae of 1925 entering hibernation and percentage of mortality of each brood during the winter of 1925–26 in the insectary at Fort Valley, Ga.*

Brood of larvae (1925) [1]	Larvae under observation	Larvae that entered hibernation		Hibernating larvae that died during winter of 1925–26	
	Number	*Number*	*Per cent*	*Number*	*Per cent*
Fifth	1,371	166	12.1	69	41.6
Sixth	1,159	749	64.6	96	11.5
Seventh	413	413	100.0	32	7.7
Total or average	2,943	1,328	45.1	187	14.1

[1] One larva of the fourth generation started to hibernate, but died late in the fall of 1925.

In 1926, 11.8 per cent of the fourth, 86.7 per cent of the fifth, and 100 per cent of the sixth broods of larvae entered hibernation, there being six broods that year. Table 11 gives the dates the first and last larva of each brood entered hibernation in 1926, and the percentage of each brood that entered hibernation.

TABLE 11.—*Dates on which the first and last larva of each brood of the oriental peach moth entered hibernation in 1926 and percentage of each brood entering hibernation, Fort Valley, Ga.*

Brood of larvae (1926)	Date first larva entered hibernation	Date last larva entered hibernation	Larvae under observation	Larvae that entered hibernation	
			Number	*Number*	*Per cent*
Fourth	Aug. 27	Sept. 24	458	54	11.8
Fifth	Sept. 7	Oct. 28	271	235	86.7
Sixth	Oct. 12	...do.....	12	12	100.0

PUPAL PERIOD

Observations on pupation were made daily by examining the larvae within the cocooning sticks. During the season of 1925 pupation records were taken on 3,676 individuals. The spring brood began to pupate on February 25. Table 12 gives the first and last pupation dates for each brood and the average, maximum, and minimum lengths of the pupal period for each brood.

TABLE 12.—*First and last pupation dates for each brood of the oriental peach moth and length of pupal period for each brood, Fort Valley, Ga., 1925*

Brood	Date of first pupation	Date of last pupation	Pupae under observation	Pupal period		
				Average	Maximum	Minimum
			Number	*Days*	*Days*	*Days*
Spring [1]	Feb. 25	Apr. 16	42	13.2	28	8
First [2]	Apr. 19	May 22	119	11.0	20	7
First [1]	May 6	June 16	73	11.4	35	6
Second [2]	May 10	June 23	260	9.4	13	5
Second [1]	May 18	June 21	129	8.8	12	4
Third [2]	May 12	July 6	131	9.0	13	5
Third [1]	June 17	July 23	649	8.4	17	5
Fourth [1]	July 13	Aug. 28	1,076	8.4	19	4
Fifth [1]	Aug. 5	Sept. 23	885	8.2	18	4
Sixth [1]	Sept. 6	Oct. 13	312	8.3	24	5

[1] Reared in insectary. Part of the spring-brood material was sent to Fort Valley from Maryland. Some of the first-brood larvae were reared in peach twigs, hence the late pupation. No larvae of the seventh generation pupated in the fall of 1925.
[2] From larvae collected in the field.

During the season of 1926 pupation records were taken on 2,536 individuals. The spring brood began to pupate on February 24, one day earlier than the first pupation record in 1925. However, one less generation occurred in 1926 as a result of the long pupation period of the spring brood and the lower September temperatures. Table 13 gives the first and last pupation dates for each brood and the average, maximum, and minimum length of the pupal period for each brood.

TABLE 13.—*First and last pupation dates for each brood of the oriental peach moth and length of pupal period for each brood in the insectary, Fort Valley, Ga., 1926*

Brood	Date of first pupation	Date of last pupation	Pupae under observation	Pupal period		
				Average	Maximum	Minimum
			Number	*Days*	*Days*	*Days*
Spring	Feb. 24	May 29	986	18.7	50	6
First	May 8	June 18	340	9.7	13	7
Second	June 10	July 22	478	9.3	13	4
Third	July 9	Aug. 23	414	8.6	17	5
Fourth	Aug. 7	Sept. 14	287	8.1	12	5
Fifth	Sept. 2	Sept. 20	31	8.8	12	6

MOTH EMERGENCE

In 1925 the first moth of the spring brood emerged on March 8 and the last moth emerged April 28. Moths of the first brood began to emerge April 28 and continued until July 8, the late-emerging moths

being from larvae sent from Maryland. The second-generation moths began to emerge May 21 and continued emerging until July 8. Moths of the third generation started to emerge June 20 and continued until August 2. The fourth-generation moths started to emerge July 20 and continued until September 4. Those of the fifth generation began to emerge August 12 and continued until October 14, and those of the sixth generation emerged during the period from September 15 to October 25.

In 1926 the first moth of the spring brood did not emerge until March 28, and the last moth of that brood emerged June 8. Moths of the first brood began to emerge May 19 and continued emerging until June 29. Second-generation moths began to emerge June 18 and continued until August 1. Moths of the third generation started to emerge July 17 and continued until August 31. Fourth-generation moths emerged during the period from August 14 to September 23. A single moth (female) of the fourth generation emerged November 5, which is the latest moth-emergence record for this latitude. Fifth-generation moths emerged during the period from September 10 to September 27.

In all, 3,754 moths were reared during the season of 1925; 101 of these were of the spring brood, 101 of the first generation, 129 of the second generation, 723 of the third generation, 1,251 of the fourth generation, 1,081 of the fifth generation, and 368 of the sixth generation. The peak of emergence of each brood of moths was as follows: Spring brood, April 25; first brood, May 22; second brood, June 13; third brood, July 24; fourth brood, August 10; fifth brood, August 31; sixth brood, September 21. The daily rate of emergence of moths during the season of 1925 is shown in graphic form in Figure 1.

Altogether, 2,960 moths were reared during the season of 1926; 991 of these were of the spring brood, 414 of the first generation, 589 of the second generation, 541 of the third generation, 391 of the fourth generation, and 34 of the fifth generation. The peak of emergence of each brood of moths was as follows: Spring brood, April 26; first brood, June 11; second brood, July 2; third brood, August 2; fourth brood, August 31; fifth brood, September 20. The daily rate of emergence of moths during the season of 1926 is shown in graphic form in Figure 2.

LENGTH OF LIFE OF MOTHS

During 1925 daily records were kept on the length of life of 1,406 male and 1,243 female oriental peach moths. The males lived an average of 9.9 days and the females an average of 10.6 days. Table 14 gives the average, maximum, and minimum length of life of moths of each generation in 1925.

TABLE 14.—*Length of life of male and female oriental peach moths at Fort Valley, Ga., during the season of 1925*

Brood	Male moths				Female moths			
	Number	Length of life			Number	Length of life		
		Average	Maximum	Minimum		Average	Maximum	Minimum
		Days	*Days*	*Days*		*Days*	*Days*	*Days*
Spring	58	11.1	24	1	32	13.4	20	1
First	76	10.6	18	2	86	10.9	17	3
Second	249	7.5	17	1	180	8.5	16	1
Third	347	8.6	17	1	263	8.7	20	1
Fourth	343	10.9	20	1	353	10.4	19	1
Fifth	239	10.1	20	1	228	10.7	22	2
Sixth	94	11.0	22	1	92	11.5	20	2
Total or average	1,406	9.9	24	1	1,243	10.6	22	1

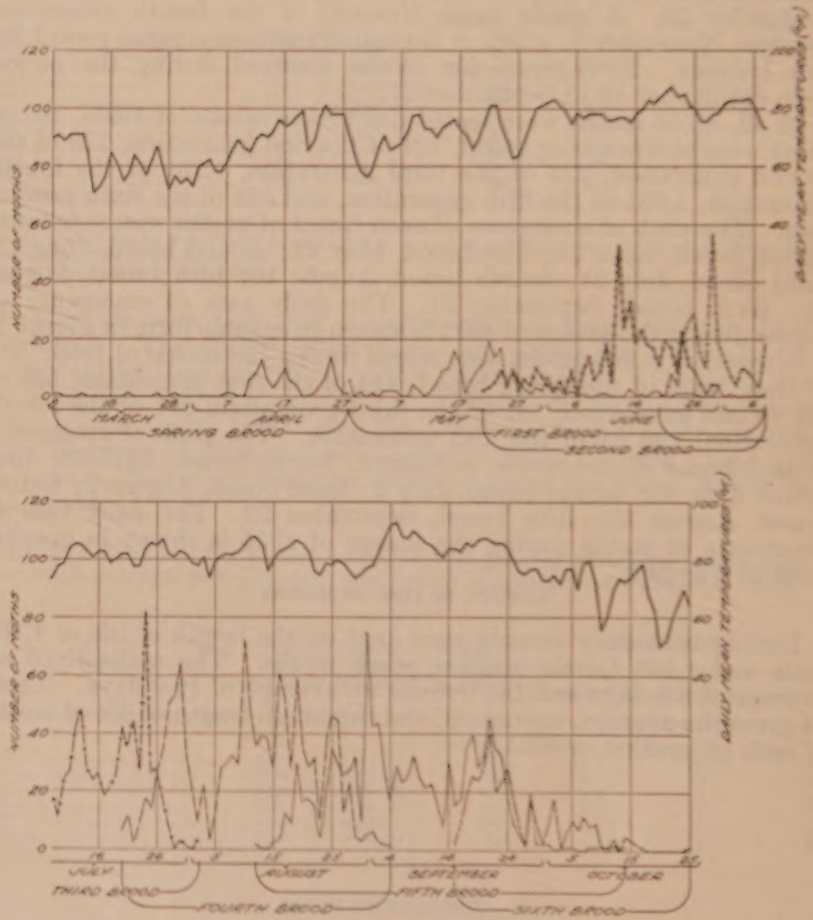

FIGURE 1.—Emergence of 3,754 oriental peach moths at Fort Valley, Ga., season of 1925

During 1926 records were kept on the length of life of 475 male and 508 female oriental peach moths. The males lived an average of 11.6 days and the females an average of 12.5 days. Table 15

gives the average, maximum, and minimum length of life of females of each generation in 1920.

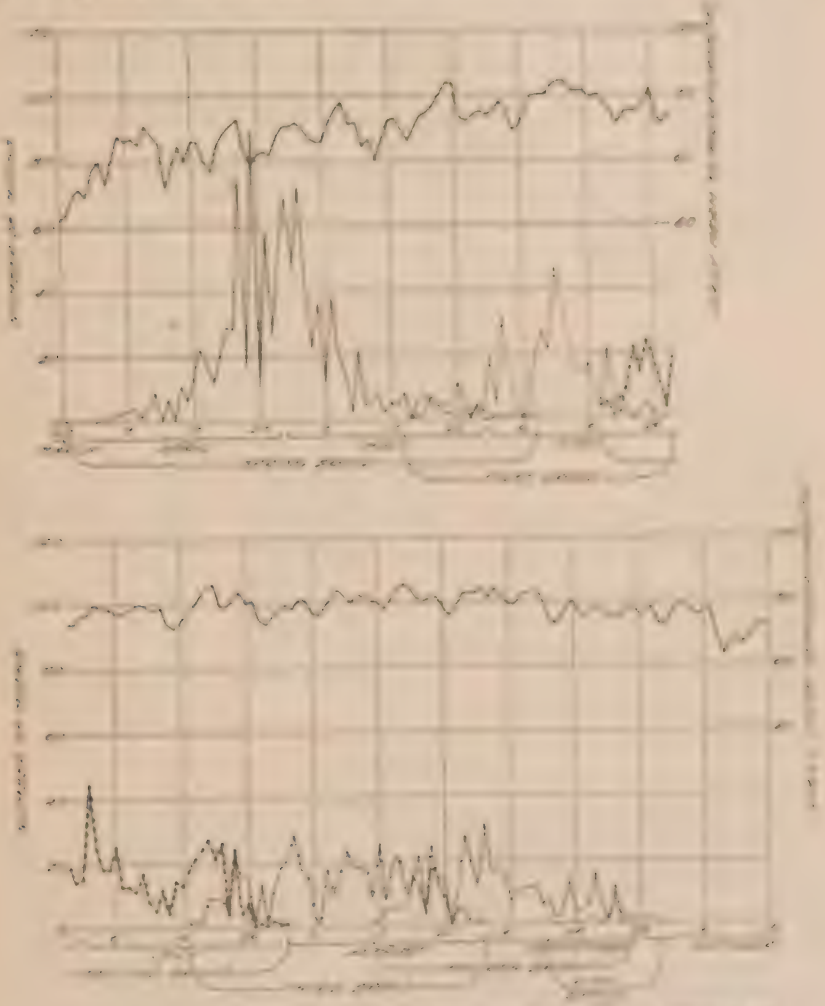

FIGURE 3.—Emergence of both oriental peach moths at Fort Valley, Ga., summer of 1920

TABLE 1A.—*Length of life of male and female oriental peach moths in Fort Valley, Ga., during the season of 1920*

Brood	Males				Females			
	Number	Length of life			Number	Length of life		
		Average	Maximum	Minimum		Average	Maximum	Minimum
		Days	Days	Days		Days	Days	Days
Spring	54	11.9	20	4				
First summer	64	11.4	21	4				
Second summer	77	12.1	23	4				
Third summer	65	11.2	20	4				
Fourth summer	9	12.1	16	8				
Total or average	269	12.3	23	4	269	12.3	20	4

SUMMARY OF THE LIFE HISTORY OF THE ORIENTAL PEACH MOTH IN GEORGIA

Table 16 gives a summary of the length of time required for each generation of the oriental peach moth to pass through the several stages in the life cycle. The average time required to complete the entire life cycle in 1925 ranged from 24.8 to 43.5 days, and in 1926 it ranged from 24.5 to 32.8 days. The first and last generations required more time to complete their life cycle than did those in midseason on account of the cooler weather in the spring and fall.

TABLE 16.—*Summary of the life history of the oriental peach moth in Georgia, 1925 and 1926*

Generation	Average length of incubation period of egg	Average length of larval feeding period in fruit	Average length of cocooning period	Average length of pupal period	Average length of life cycle	Average number eggs deposited per female
1925:	*Days*	*Days*	*Days*	*Days*	*Days*	
Spring						[illegible]
First	4.3	18.2	3.5	11.4	37.5	6.4
Second	4.3	11.3	3.1	8.8	27.5	16.9
Third	2.3	10.3	2.6	8.4	24.6	20.5
Fourth	2.2	12.0	2.9	8.4	25.5	62.9
Fifth	3.4	11.4	3.0	8.2	26.0	20.0
Sixth	3.5	14.7	2.6	8.3	29.1	66.4
Seventh	4.0	19.2	(1)			
1926:						
Spring				[illegible]		[illegible]
First	3.7	15.7	3.6	9.7	32.5	35.7
Second	3.7	11.1	2.9	9.3	27.1	64.6
Third	3.7	10.8	2.7	8.6	25.9	63.5
Fourth	3.4	10.6	2.5	8.1	24.5	56.9
Fifth	3.7	12.9	2.7	8.6	28.1	37.9
Sixth	4.2	16.5	(1)			

[1] None pupated.

PARASITES

Parasites of the oriental peach moth are apparently very scarce in the region around Fort Valley, Ga. A large quantity of oriental peach moth material was collected in the field during 1925 and 1926 in connection with the life-history studies, and from it only three parasites were taken. These were *Limnerium peachi* Cog. (Diptera) May 31, 1925; a species of Apantoles (Hymenoptera) June 10, 1925; and a new species of Exodiston (Hymenoptera) June 14, 1926.

A considerable number of larvae collected in the field during 1925 and 1926 were found to be attacked by an undetermined wilt.

MISCELLANEOUS NOTES

TIME REQUIRED FOR LARVAE TO ENTER PEACH TWIGS

Two larvae in the third instar were removed from infested twigs of the new growth of a 2-year-old peach tree on April 16, 1926, and at 2 p. m. they were placed on fresh uninfested peach twigs. Larva No. 1 wandered about on the leaves for about five minutes and then started to rasp the tissue of the midrib of one of the uppermost leaves at the tip of the twig. The leaf tissue was not eaten but was cast to one side as the larva worked, being held together by silk. By 3.30 p. m. the larva had bored in, and it disappeared into the stalk at 4.15 p. m. At 4.45 p. m. it had not bored farther than just to

enter the stalk. Larva No. 2 had just molted when removed from an infested twig. At 3.30 p. m. it had spun a silken case around itself and had begun slowly to rasp the tissue. At 4.45 p. m. this larva ceased to work. In another observation a first-instar larva entered a peach twig one hour after it was placed on the plant.

WEEKLY COLLECTIONS OF INFESTED TWIGS TO DETERMINE ABUNDANCE OF LARVAE IN THE FIELD

In 1926 infested twigs were collected for one hour each week in two orchards in the center of the Georgia peach belt. The results of these collections, together with the average number of larvae which hatched daily each week in the insectary, are shown in graphic form in Figure 3. It is evident that the peaks in the insectary records correspond rather closely to those in field collections.

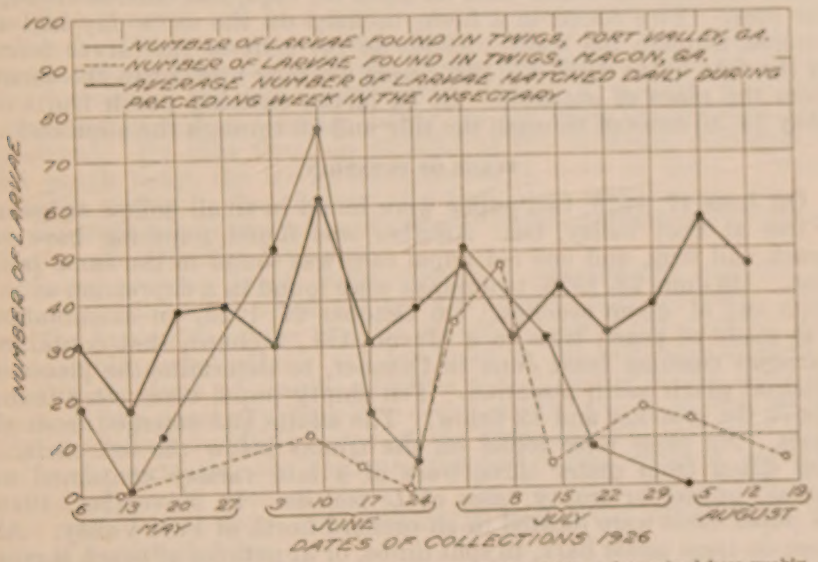

FIGURE 3.—Abundance of oriental peach moth larvae in the field, as determined from weekly collections of infested peach twigs, compared with the average number of larvae which hatched daily during the preceding week in the insectary at Fort Valley, Ga., 1926

The orchard at Fort Valley was an old bearing orchard, and the twigs had hardened by August 2. No further larval work was found in the twigs. The orchard at Macon was a well-fertilized 1-year-old orchard in which the twigs started hardening about August 3. Practically all the twigs had hardened by August 24, although a few larvae were found in twigs as late as October 15, these standing a much better chance of successfully hibernating.

FIRST APPEARANCE OF LARVAE IN THE FIELD

At Fort Valley, Ga., the first larvae found in the field in 1925 were seen April 10. They probably hatched April 6. In the insectary the first egg hatched April 19. In 1926, full-grown larvae were found in the field on May 5, and in the insectary on May 3. Second-brood larvae only a few days old were found in the field on May 26, 1926, while the first eggs of the second generation hatched in the insectary on

May 27. In 1927, the first larvae found feeding in the twigs in the field were seen April 2. In 1928, the first larvae (about two days old) were found in the field on April 25. The latest date on which a larva was found in the field was October 15, 1926, at Macon, Ga., when a nearly full grown individual, probably of the sixth generation, was observed feeding in a peach twig. According to the field notes the stages of each generation appeared in the field from two to four days earlier than they did in the insectary.

PLACE OF ENTRANCE OF LARVAE INTO HOST

Observations on 7 larvae on April 11, 1925, showed that 3 entered the shoots through the leaf petiole and 4 entered just below the base of the petiole through the stem. Of 2 others, 1 entered through the petiole, and 1 entered through the stem between nodes. One found in a commercial orchard on April 13, 1925, had entered through the stem. Five found in a home orchard on the same day had all entered through the stem. About 50 per cent of the larvae found in the field up to April 13, 1925, were working upward in the shoots from the place of entrance. Of 56 larvae entering peach fruits on May 14, 30 entered through the side and 26 through the stem end.

PLACE OF PUPATION

On June 17, 1925, two pupae were found in small hollow twigs on a tree at Fort Valley, Ga. Another was found pupating between peach and twig, and one old pupal case was found in the same position. On June 22, 1925, two pupae were found in a depression at the stem end of green peaches. On October 27, 1925, an examination was made of peach trees in a Macon, Ga., orchard, that contained varieties ripening from June to October, to determine the places of oriental peach moth pupation. Ten empty pupal cases were found above the crotches and 12 below. The adults had emerged from all cases. No cases were found on the trunks below the soil surface. Soil sifted from under three trees of a late variety contained no larvae, pupae, or empty cases of *L. molesta*. In November, 1926, 24 pupal cases were located in an orchard north of Fort Valley. All were on trees under bark, in split limbs, or at petioles of peach leaves. Two hibernating larvae were located in a hollowed-out twig from which the pith had been removed.

ABUNDANCE AND SPREAD

In the Fort Valley (Ga.) region the infestation in 1925 was confined to peach trees within the city limits of Fort Valley and Macon and to parts of seven commercial orchards. In 1926 there was a marked decrease in the infestation, and that year only a few trees within the city limits and parts of two commercial orchards were infested. There was an increase in 1927. An observation on April 4, 1927, in one of the commercial orchards infested in 1925 and 1926 revealed more larvae than ever before at that time of the year. There were about as many present as could be found at the height of infestation the summer before. The infestation within the city limits was heavy, and during the season the insect spread to orchards 12 miles north, 15 miles south, 6 miles east, and 6 miles west of the city of Fort Valley. However, the infestation was very light throughout the area. There was also an increased infestation in other sections

of the Georgia peach belt in 1927. There was a marked decrease again in the infestation in the early part of 1928. The insect was late getting started in the spring. A commercial orchard north of Fort Valley that had always shown the heaviest infestation had less than one-tenth as many injured twigs in it on July 9, 1928, as it had had at the same time in 1927. During 1928 the insect spread 7 miles farther south, in the Fort Valley region, than the southern limit in 1927, and in one orchard near Marshallville the infestation was fairly heavy, but throughout the whole infested area in middle Georgia in 1928 the injury from the insect was of no economic importance.

STATUS OF THE ORIENTAL PEACH MOTH INFESTATION IN GEORGIA

The oriental peach moth has not been and is not now of any economic importance in the central Georgia peach belt. The chances are that it never will be a pest of major importance in that section unless fruit that matures late in the season is planted, because no host is afforded for the maturity of the last three broods of larvae. The harvest of the latest commercial variety of peaches is usually completed in central Georgia before the last three broods have been produced. By that time, on account of the hardened condition of the peach twigs, the larvae have ceased to work in them. Consequently, owing to the absence of a host after midsummer, there is an apparent heavy mortality of oriental peach moth larvae of broods that would otherwise hibernate.

Young growing peach twigs contain a considerable quantity of water-soluble sugars which the larva is able to utilize as food. During the hardening of the twig its growth is practically stopped, and the soluble carbohydrates are deposited in the pith and medullary rays in the form of starch, which is not available to the larva for food, as the necessary digestive enzymes are lacking in this insect. The decreased nutritive value of the twig and the increased difficulty of penetrating the hardened lignified tissues result in the starvation of a large number of larvae. In the latter part of the summer small larvae have very frequently been found dead within the tips of hardened twigs.

In 1925 fourth-brood larvae were making their appearance in the middle Georgia peach belt during the harvest of Elberta peaches, the last commercial variety to ripen in the State. No larvae of the fourth brood hibernated in 1925. The fifth, sixth, and seventh generations were reared in the insectary after the peach harvest that year, and 12 per cent of the fifth, 65 per cent of the sixth, and 100 per cent of the seventh brood larvae hibernated. In 1926, third-brood larvae were making their appearance in the middle Georgia peach belt during the harvest of the last commercial variety of peaches, but no larvae of that brood hibernated in 1926. The fourth, fifth, and sixth generations were reared in the insectary after the peach harvest that year, and 12 per cent of the fourth, 87 per cent of the fifth, and 100 per cent of the sixth brood larvae hibernated. Thus it appears that the broods of oriental peach moth larvae that hibernate in middle Georgia are not produced until after the fruit has been harvested and the twigs have hardened.

A few larvae yearly reach maturity late in the season in water sprouts or sucker growth of neglected orchards or in the twigs of

late-growing trees. These are able to hibernate and start the infestation again the following spring. In an exceptional year, when late rains force vigorous twig growth late in the summer, a sufficient number of larvae may be able to reach maturity and hibernate to cause commercial damage the following season if conditions are then favorable for their increase.

In latitudes where the insect produces six or seven broods of larvae annually, its hosts would perhaps be subjected to severe attacks if field conditions were favorable for the rearing of the later generations. The heavy mortality of larvae of the broods that hibernate in middle Georgia has held this insect in check.

While the insect has been spreading in the Georgia peach belt since it became established, the infestations in the central part are light and are to date of no economic importance. In the northern part of the Georgia peach belt considerably heavier infestations have been reported by C. H. Alden of the Georgia State Board of Entomology, and the insect is likely to become of considerable economic importance there. In that section apples are raised, and the later broods of oriental peach moth larvae are able to mature in the fruit and hibernate in sufficient numbers to injure peaches seriously the following season.

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